

aquaradio® Mobile Receiver

Portable radio transmitter and receiver with Bluetooth interface

User manual



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1. Index of publication

Version	Date	Changes
01	15/04/2024	First version
02	08/10/2026	Update standard delivery contents & adding the USB-C Connector

2. Contact of the organization

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3. Introduction

The **aquaradio® Mobile Receiver** is a portable radio receiver with Bluetooth interface for wireless M-Bus resource meters (currently for mode T1, T2 and C1). A rechargeable lithium ion battery allows an operating time of up to 20 hours on one charge.

The **aquaradio® Mobile Receiver** is usually used together with a portable computer for mobile reading of radio consumption meters (electricity, gas, water, heat and others).

Due to the waterproof housing (IP 64) and the mechanically robust construction (EN 60721 Class 7M3), the device can also be used in harsh environmental conditions without further housing protection. Furthermore, **the aquaradio® Mobile Receiver is equipped with a serial interface to which devices for configuring consumption meters can be connected, for example.**

4. Important notes

- The **aquaradio® Mobile Receiver** is used for the mobile reception of M-Bus mode T1, T2 and C1 radio consumption meter telegrams and their transmission to a portable computer via a Bluetooth interface.
- The **aquaradio® Mobile Receiver** may only be put into operation by skilled workers.
- The **aquaradio® Mobile Receiver** may only be used in environments that correspond to its housing protection class (IP 64) and its operating temperature (-5° C to +55° C).
- The built-in lithium-ion battery must not be charged at temperatures below 0° C or above +45° C (charging the battery only at temperatures of +0° C to +45° C).
- Only the supplied charger may be used to charge the **aquaradio® Mobile Receiver** battery. The charger may only be used with the correct plug-in adapter. The charger may only be used in dry, weather-protected places.
- No force must be used to plug the round battery charging plug into the **aquaradio® Mobile Receiver**. The plug must be rotated until it slides smoothly into the device socket. The plug must only be screwed lightly.
- The **aquaradio® Mobile Receiver** must be fully charged before using it for the first time.
- The **aquaradio® Mobile Receiver** is not a calibrated measuring device. The transmitted consumption meter readings and consumption are of a purely informal nature.
- In case of malfunctions, please do not repair the device yourself, as this will void any warranty claim. Give the device to your supplier for repair.
- Do not open the housing. In particular, do not try to remove, replace or open the built-in lithium ion battery. Under no circumstances should the lithium ion battery be short-circuited.

5. Scope of delivery and packaging



Please make sure that the scope of delivery is complete. The scope of delivery of the **aquaradio® Mobile Receiver** includes:

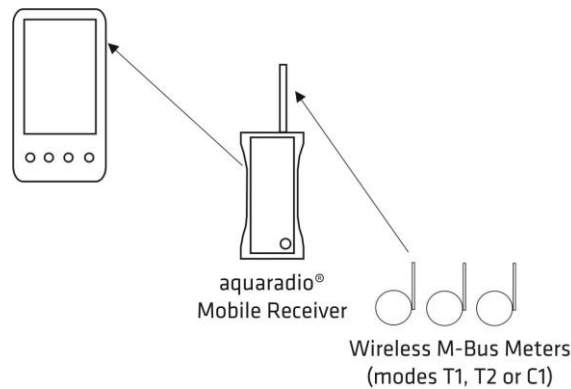
- 1 **aquaradio® Mobile Receiver**
- 1 antenna
- 1 Quick Start Guide
- 1 CD with documentation

Packaging is reusable or can be returned to the raw material cycle. Please dispose of packaging material that is no longer required properly. If you notice any transport damage during unpacking, please contact your supplier immediately.

Make sure that the packaging film does not get into the hands of children. There is a risk of suffocation!

6. Functional principle

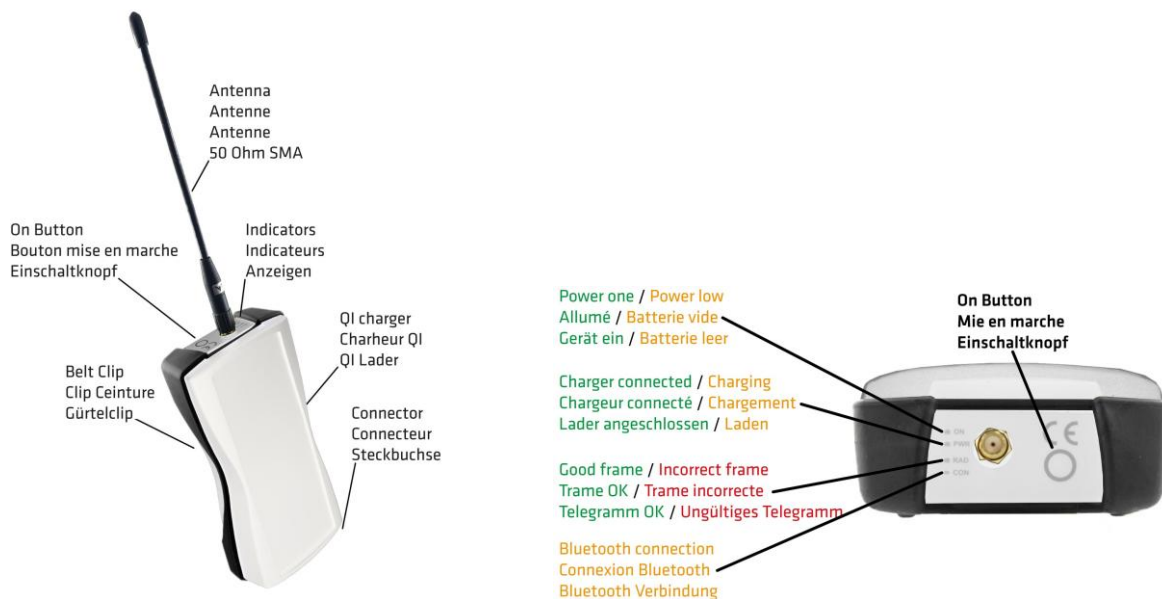
The **aquaradio® Mobile Receiver** is a radio receiver for wireless M-Bus mode T1, T2 and C1 consumption meters (electricity, gas, water, heat and others). The received radio telegrams of the consumption meters are temporarily stored in an internal memory and immediately transmitted to a portable computer via the Bluetooth interface, provided that the Bluetooth connection is established. If the Bluetooth connection is not established, the **aquaradio® Mobile Receiver** collects all received radio telegrams (up to 150) and then transmits them at once as soon as a Bluetooth connection is available again.



Due to its built-in, rechargeable lithium-ion battery, the **aquaradio® Mobile Receiver** has an operating time of about 20 hours on one charge (without using the external serial port). Recharging the battery takes between 4 and 5 hours, depending on the charge level of the battery.

The **aquaradio® Mobile Receiver** has a 50 Ohm SMA antenna socket for corresponding antennas.

7. Overview



Antenna:

The antenna may only be screwed onto the SMA socket by hand. It is possible to use any 868 MHz, 50 Ohm antenna, such as a car roof antenna. However, it cannot be guaranteed that other antennas will receive or receive at all as well as the supplied antenna. In principle, the warranty of the device expires if another antenna is used, if active antennas are used or if antenna preamplifiers are used. When screwing on the antenna, no electrostatic discharges must occur.

Power button:

Press this button to turn on the **aquaradio® Mobile Receiver**. The power indicator lights up green. After about 5 seconds, the internal self-test is finished and the device is ready to receive radio telegrams.

The device will automatically turn off after 10 minutes if there is no Bluetooth connection.

If the power button is pressed for more than 5 seconds, the device will be turned off manually.

Plug:

The battery charging plug is located at the bottom of the device.

In addition to battery charging, the connector also serves as an interface for external, serial devices. Therefore, it is not possible to connect the battery charger and an external, serial device at the same time.

QI Loader:

For wireless charging, the **aquaradio® Mobile Receiver** can be placed in the middle of a QI charger.

LED device on / LED battery empty:

Device is on (ON)

Battery drained (ON)

The power indicator lights up green when the device is turned on. When the battery level becomes critical, the indicator lights up orange. In this case, the device should be connected to the battery charger as soon as possible. Approximately 4 minutes after the orange indicator, the device will automatically turn off.

LED charger connected:

Charger is connected (PWR)

LED battery empty:

Akku grafts (PWR)

The PWR battery charge indicator lights up orange when the charger is connected to the **aquaradio® Mobile Receiver** and the internal lithium ion battery is charged. When the battery is fully charged, the PWR indicator lights up green and the charger can be disconnected from the **aquaradio® Mobile Receiver**. Due to the low self-discharge of the lithium ion battery, it is not necessary to permanently connect the charger to the **aquaradio® Mobile Receiver**.

Radio Reception Indicator:

Valid radio telegram (RAD)

Invalid Radio Telegram (RAD)

The RAD radio telegram indicator lights up green when a valid radio telegram has been received. The RAD radio telegram indicator lights up red when an invalid (faulty) radio telegram has been received.

NOTE:

If the wireless telegram indicator RAD and the ON indicator both flash red, then the internal self-test has detected an error. In this case, manually turn the device off and then on again. If the error persists, please send the device in for repair.

Bluetooth Display:

Flashes 1x slowly: no Bluetooth connection (CON)

Flashes 2x fast: Bluetooth connection (CON)

The Bluetooth CON indicator lights up orange briefly a few seconds after the device has been switched on. If the orange CON indicator is permanently lit, there is a fault in the Bluetooth module.

In this case, the device must be switched off and on again.

If the orange CON indicator flashes slowly 1x, no Bluetooth connection has been established.

When the orange CON indicator flashes 2x fast, a Bluetooth connection is established.

8. Establishing a Bluetooth connection

After switching on the **aquaradio® Mobile Receiver** and before establishing a Bluetooth connection, you must wait for about 5 seconds. This time is necessary for the internal initialization of all **aquaradio® Mobile Receiver** modules. After that, you need to go to the Bluetooth configuration page on your portable computer and start a Bluetooth device search. The procedure varies from computer to computer, so you should also consult your computer's manual or online help.

With the Bluetooth name or serial number of the **aquaradio® Mobile Receiver** on the label on the back of the device (e.g. **aquaradio® Mobile Receiver** 0ABB01) you can check whether it was found correctly.

If you are asked for a pairing code/connection key/PIN, please enter zero four times: 0000.

After that, you should connect the **aquaradio® Mobile Receiver** to a virtual serial profile protocol (SPP). This is also done via the Bluetooth configuration page of your computer. Please note the serial port assigned to the **aquaradio® Mobile Receiver** (e.g. COM12). By opening this serial port, a connection to the **aquaradio® Mobile Receiver** will automatically be established and you can send commands to the device.

9. Bluetooth Communication

After you have connected the **aquaradio® Mobile Receiver** to a virtual serial port of your portable computer, you can start reading the radio telegrams. The virtual serial port should be opened as follows:

115200,8,N,1

115200 Baud, 8 Data Bits, No Parity Bit, 1 Stop Bit, Hardware Flow Control or No Flow Control

9.1. Command Format

The general command format for **aquaradio® Mobile Receiver** communication is (all bytes hexadecimal):

01 FE LL CD [Data] CRC CRC

01 FE :	Two start bytes
LL :	Length byte (length over all including start character and CRC)
CD :	Command Byte
[Data] :	0... 249 bytes of data
CRC CRC :	Cyclic redundancy check, MSB is transferred first

The CRC is calculated using the following producer polynomial:

$$X^{16} + X^{13} + X^{12} + X^{11} + X^{10} + X^8 + X^6 + X^5 + X^2 + 1$$

The CRC is calculated over all bytes of the instruction except the CRC itself (from the first start byte to the last byte before the CRC).

Below is an example code for calculating the CRC:

```
WORD CRCTable[256]={
    0x0000,0x3D65,0x7ACA,0x47AF,0xF594,0xC8F1,0x8F5E,0xB23B,
    0xD64D,0xEB28,0xAC87,0x91E2,0x23D9,0x1EBC,0x5913,0x6476,
    0x91FF,0xAC9A,0xEB35,0xD650,0x646B,0x590E,0x1EA1,0x23C4,
    0x47B2,0x7AD7,0x3D78,0x001D,0xB226,0x8F43,0xC8EC,0xF589,
    0x1E9B,0x23FE,0x6451,0x5934,0xEB0F,0xD66A,0x91C5,0xACA0,
    0xC8D6,0xF5B3,0xB21C,0x8F79,0x3D42,0x0027,0x4788,0x7AED,
    0x8F64,0xB201,0xF5AE,0xC8CB,0x7AF0,0x4795,0x003A,0x3D5F,
    0x5929,0x644C,0x23E3,0x1E86,0xACBD,0x91D8,0xD677,0xEB12,
    0x3D36,0x0053,0x47FC,0x7A99,0xC8A2,0xF5C7,0xB268,0x8F0D,
    0xEB7B,0xD61E,0x91B1,0xACD4,0x1EEF,0x238A,0x6425,0x5940,
    0xACC9,0x91AC,0xD603,0xEB66,0x595D,0x6438,0x2397,0x1EF2,
    0x7A84,0x47E1,0x004E,0x3D2B,0x8F10,0xB275,0xF5DA,0xC8BF,
    0x23AD,0x1EC8,0x5967,0x6402,0xD639,0xEB5C,0xACC3,0x9196,
    0xF5E0,0xC885,0x8F2A,0xB24F,0x0074,0x3D11,0x7ABE,0x47DB,
    0xB252,0x8F37,0xC898,0xF5FD,0x47C6,0x7AA3,0x3D0C,0x0069,
    0x641F,0x597A,0x1ED5,0x23B0,0x918B,0xACEE,0xEB41,0xD624,
    0x7A6C,0x4709,0x00A6,0x3DC3,0x8FF8,0xB29D,0xF532,0xC857,
    0xAC21,0x9144,0xD6EB,0xEB8E,0x59B5,0x64D0,0x237F,0x1E1A,
    0xEB93,0xD6F6,0x9159,0xACC3,0x1E07,0x2362,0x64CD,0x59A8,
    0x3DDE,0x00BB,0x4714,0x7A71,0xC84A,0xF52F,0xB280,0x8FE5,
    0x64F7,0x5992,0x1E3D,0x2358,0x9163,0xACC6,0xEBA9,0xD6CC,
    0xB2BA,0x8FDF,0xC870,0xF515,0x472E,0x7A4B,0x3DE4,0x0081,
    0xF508,0xC86D,0x8FC2,0xB2A7,0x009C,0x3DF9,0x7A56,0x4733,
    0x2345,0x1E20,0x598F,0x64EA,0xD6D1,0xEBB4,0xACC1B,0x917E,
    0x475A,0x7A3F,0x3D90,0x00F5,0xB2CE,0x8FAB,0xC804,0xF561,
    0x9117,0xAC72,0xEBDD,0xD6B8,0x6483,0x59E6,0x1E49,0x232C,
    0xD6A5,0xEBC0,0xACC6F,0x910A,0x2331,0x1E54,0x59FB,0x649E,
    0x00E8,0x3D8D,0x7A22,0x4747,0xF57C,0xC819,0x8FB6,0xB2D3,
    0x59C1,0x64A4,0x230B,0x1E6E,0xACC55,0x9130,0xD69F,0xEBFA,
    0x8F8C,0xB2E9,0xF546,0xC823,0x7A18,0x477D,0x00D2,0x3DB7,
    0xC83E,0xF55B,0xB2F4,0x8F91,0x3DAA,0x00CF,0x4760,0x7A05,
    0x1E73,0x2316,0x64B9,0x59DC,0xEBE7,0xD682,0x912D,0xACC48};

WORD
int          CRCValue;
int          Counter;
int          BufferLen;
BYTE         Buffer[100];

BufferLen=0;
Buffer[BufferLen++]=0x01;
Buffer[BufferLen++]=0xFE;
Buffer[BufferLen++]=0x06;
Buffer[BufferLen++]=0x09;

CRCValue=0; for (Counter=0; Counter<BufferLen;++Counter)
{
    CRCValue=CRCTable[(CRCValue>>8) ^ Buffer[Counter]] ^ (CRCValue<<8);
}
Buffer[BufferLen++]=(BYTE)((CRCValue & 0xFF00)>>8); Buffer[BufferLen++]=(BYTE)(CRCValue & 0x00FF);
```

Three example commands with correct CRC:

To query the firmware version:	01 FE 06 09 3F DE
Read out radio telegram 2:	01 FE 06 10 45 09
Reading out radio telegram 3:	01 FE 06 40 E9 C0

9.2. Query Firmware Version

Returns the firmware version and device type of the **aquaradio® Mobile Receiver** (all bytes hexadecimal).

Inquiry:	01 FE 06 09 CRC CRC
Answer OK:	01 FE 0B 09 VMajor VMinor0 VMinor1 VMinor2 DType CRC CRC
Answer error:	01 FE 07 09 FF CRC CRC
VMajor :	major version number
VMinor0 :	minor version number 0
VMinor1 :	minor version number 1
VMinor2:	minor version number 2
DType :	Device type 50 = aquaradio® Mobile Receiver 868 MHz 51 = aquaradio® Mobile Receiver 434 MHz

9.3. Reading Wireless Telegram 1

Note: This command should no longer be used, use read wireless telegram 2 instead.

Delivers the next radio telegram from the buffer of the **aquaradio® Mobile Receiver** if a radio telegram is available. Version 1 of the command outputs radio telegrams with a maximum length of 120 bytes (all bytes hexadecimal):

Inquiry:	01 FE 06 06 CRC CRC
Answer OK:	01 FE 86 06 [Telegram Data]] CRC CRC
Answer error:	01 FE 86 06 FF [127 beliebige Bytes] CRC CRC

The [Telegram Data] format is:

LL T0 T1 T2 T3 T4 00 RSSI [Radio telegram]

LL	Length byte of the returned data (including the length byte to the last byte of the [radio telegram])
T0, T1, T2, T3, T4	Time difference between the reception of the radio telegram and the reading of it via the Bluetooth interface (resolution 5.3 μ s). To calculate the real radio telegram reception time, this time difference must be subtracted from the current time (Bluetooth readout time).
FE / FF	This byte contains two pieces of information: 1. If it is not zero, T0, T1, T2, T3, T4 contain the time difference between radio telegram reception and Bluetooth readout. If it is zero, then they contain the absolute timestamp of reception. 2. If the byte contains FE, the battery is exhausted (battery drained indicator). If the byte contains FF, the battery charge level is OK.
RSSI	Received signal strength indicator 0%... 100%. To convert to dBm: (RSSI - 120) dBm
[Radio telegram]	The received radio telegram, for a format specification it is necessary to consult the documentation of the radio consumption meter manufacturer. The [radio telegram] field is filled with any bytes up to a length of 120 bytes.

9.4. Reading Wireless Telegram 2

Delivers the next radio telegram from the buffer of the **aquaradio® Mobile Receiver** if a radio telegram is available. Version 2 of the command outputs radio telegrams with a maximum length of 241 bytes (all bytes hexadecimal). The **aquaradio® Mobile Receiver** can receive radio telegrams with a maximum length of 240 bytes, which means that the length byte of the radio telegram may contain a maximum of F0 (hex).

Inquiry:	01 FE 06 10 CRC CRC
Answer OK:	01 FE FF 10 [Frame data] CRC CRC
Answer error:	01 FE FF 10 FF [248 arbitrary bytes] CRC CRC

The [Telegram Data] format is:

LL T0 T1 T2 T3 T4 00 RSSI [Radio telegram]

LL	Length byte of the returned data (including the length byte to the last byte of the [radio telegram])
T0, T1, T2, T3, T4	Time difference between the reception of the radio telegram and the reading of it via the Bluetooth interface (resolution 5.3 μ s). To calculate the real radio telegram reception time, this time difference must be subtracted from the current time (Bluetooth readout time).
FE / FF	This byte contains two pieces of information: 1. If it is not zero, T0, T1, T2, T3, T4 contain the time difference between radio telegram reception and Bluetooth readout. If it is zero, then they contain the absolute timestamp of reception. 2. If the byte contains FE, the battery is exhausted (battery drained indicator). If the byte contains FF, the battery charge level is OK.
RSSI	Received signal strength indicator 0%... 100%. To convert to dBm: (RSSI - 120) dBm
[Radio telegram]	The received radio telegram, for a format specification it is necessary to consult the documentation of the radio consumption meter manufacturer. The [radio telegram] field is filled with any bytes up to a length of 120 bytes.

9.5. Reading Wireless Telegram 3

Delivers the next radio telegram from the buffer of the **aquaradio® Mobile Receiver** if a radio telegram is available. Version 3 of the command outputs radio telegrams with a maximum length of 256 bytes (all bytes hexadecimal).

If only **aquaradio® Mobile Receivers** with firmware versions 3.00 or higher are used, then this command should be used to read the radio telegram. However, if you want to read all firmware versions of the **aquaradio® Mobile Receiver**, then you should use read radio telegram 2.

NOTE: This command is only available with firmware version 3.00 or higher.

NOTE: The length field contains only the LSB of the effective length (0x128) of the command.

Inquiry:	01 FE 06 40 CRC CRC
Answer OK:	01 FE 28 40 00 [Telegram Data] CRC CRC
Answer error:	01 FE 28 40 FF [289 beliebige bytes] CRC CRC

The [Telegram Data] format is:

[Radio telegram]	256 bytes with the radio telegram and then any bytes as filler bytes. The first byte contains the length of the radio telegram. If no radio telegram is available for reading in the buffer of the aquaradio® Mobile Receiver (no reception), then the length byte is 0 and the radio telegram, RSSI, radio mode and time stamp are invalid. However, the statistics values (radio telegrams T OK etc.) are valid.
RSSI	Received signal strength indicator 0%... 100%. To convert to dBm: (RSSI - 120) dBm
Timestamps	1 byte with 0

Wireless mode	1 byte: 0x00 = 868 MHz T1 0x01 = 868 MHz C1A 0x02 = 868 MHz C1B 0x03 = 868 MHz S1 0x04 = 868 MHz C2A 0x05 = 868 MHz C2B 0x10 = 434 MHz T1 0x11 = 434 MHz C1A 0x12 = 434 MHz C1B 0x13 = 434 MHz S1 0x14 = 434 MHz C2A 0x15 = 434 MHz C2B 0xFF = unknown NOTE: Wireless mode is only available on firmware version 3.42 or later. On lower firmware versions, this byte is invalid (0xFF).
Invalid 1	1 byte not used (0xFF)
Invalid 2	1 byte not used (0xFF)
Timestamps	4 bytes with the number of seconds from the start of the aquaradio® Mobile Receiver to the reception of the radio telegram (LSB first)
Invalid 3	4 bytes not used (0xFFFFFFFF)
Radio telegrams T	4 bytes (LSB first) Number of correctly received radio telegrams Mode T
Funktelegr CA	4 bytes (LSB first) Number of correctly received radio telegrams Mode C (Format A)
BFunktelegr CB	4 bytes (LSB first) Number of correctly received radio telegrams Mode C (format B)
Error 3 out of 6	4 bytes (LSB first) Number of radio telegrams received with 3 out of 6 errors
Error CRC	4 bytes (LSB first) Number of radio telegrams received with CRC error

9.6. Receiver Mode

Select the receiver mode (T1/C1 or S1) and the reception frequency (868 MHz or 434 MHz). Reception on 434 MHz has a very short range and is only used to test 434 MHz wireless counters, for example.

Note: This command is only available from version 2.200 of the firmware.

Inquiry:	01 FE 07 15 Modus CRC CRC
Answer OK:	01 FE 07 15 Modus CRC CRC
Answer error:	01 FE 07 15 FF CRC CRC
Mode:	00 : T1/T2/C1, 868 MHz (default after switching on the device) 01 : S1, 868 MHz 10 : T1/T2/C1, 434 MHz 11 : S1, 434 MHz

9.7. Turn on the external serial port

Turns on the external serial port and configures it with the parameters passed (all bytes hexadecimal). After turning on the **aquaradio® Mobile Receiver**, the external serial port is

turned off and will be turned on with this command. To maximize battery life, the external serial port should be turned off when it is no longer in use.

Inquiry:	01 FE 09 12 BD PR TO CRC CRC
Answer OK:	01 FE 07 12 00 CRC CRC
Answer error:	01 FE 07 12 FF CRC CRC
BD :	Baud rate to use: 00 : 300 Baud 01 : 600 Baud 02 : 1200 Baud 03 : 2400 Baud 04 : 4800 Baud 05 : 9600 Baud 06 : 19200 Baud 07 : 38400 Baud 08 : 57600 Baud 09 : 115200 Baud 0A : 230400 Baud 0B : 460800 Baud AA : Turn off the external serial port
PR :	00 : 8 data bits; no parity bit 01 : 8 Datenbits + Parity Odd Bit 02 : 8 Datenbits + Parity Even Bit
TO :	Timeout in 0.35 seconds, default = 6 (2.1 seconds) This is the time it takes to wait for a response from an external device connected to the aquaradio® mobile receiver .

9.8. Sending Data Using the External Serial Port

After the external serial port has been turned on, it is possible to communicate with a connected device (all bytes hexadecimal).

Inquiry:	01 FE LL 13 MM [Data] CRC CRC
Answer OK:	01 FE 07 13 00 CRC CRC
Answer error:	01 FE 07 13 FF CRC CRC
LL :	Length of the request (from the first start byte to the last CRC)
MM :	Number of Bytes in [Data]
[Data] :	Data to be sent to the external serial port (max. 245 bytes)

9.9. Send data with wake-up command via the external serial port

After the external serial port has been switched on, it is possible to communicate with a connected device (all bytes hexadecimal). This command supports the sending of a wake-up command via an optical interface (e.g. 01010101... sequence with the selected baud rate). To send a wake-up command before the actual data to the serial port, the byte CC (see below) DH:DL is repeatedly output on the serial port. A pause of 50 ms is inserted between the

wake-up command and the actual data telegram. For example, with 0x55 as byte CC, a 01010101... sequence with variable length can be realized. The byte for the wake-up command is always sent without a parity bit.

Inquiry:	01 FE LL 0C CC DL DH MM [Daten] CRC CRC
Answer OK:	01 FE 07 0C 00 CRC CRC
Answer error:	01 FE 07 0C FF CRC CRC

LL :	Length of the request (from the first start byte to the last CRC)
CC :	Bytes for the wake-up command, usually 0x55 or 0x00
DL :	Least significant byte of the number of repetitions of byte CC
DH :	Most significant byte of the number of repetitions of byte CC
MM :	Number of Bytes in [Data]
[Data] :	Data to be sent to the external serial port (max. 242 bytes)
Examples:	2.2 seconds 0101010101... Sequence according to EN1434-3: 300 baud: 300 baud : CC=0x55, DL=0x42, DH=0x00 2400 baud : CC = 0x55, DL = 0x10, DH = 0x02 9600 baud : CC = 0x55, DL = 0x40, DH = 0x08

9.10. Reading data from the serial port

After data has been sent via the serial port, the **aquaradio® Mobile Receiver** waits for the timeout time (TO) for data sent back. If a response has been sent from the external device, it can be read out with this command:

Inquiry:	01 FE 06 14 CRC CRC
Answer OK:	01 FE FE 14 MM [Data + FF up to 245 bytes] CRC CRC
Answer error:	01 FE FE 14 00 [245 beliebige Bytes] CRC CRC

MM :	00 : No bytes received FF : It is still waiting for the external device Otherwise: Number of valid bytes in [data] received via the serial port
[Data]	Data received via the external serial port.

9.11. Sending radio telegrams

The **aquaradio® Mobile Receiver** as a bidirectional radio transceiver is able to send radio telegrams. In general, the configured radio telegram is sent when a radio telegram has been received by the corresponding consumption meter. Therefore, with this command, the radio telegram is not sent immediately, but only stored in the **aquaradio® Mobile Receiver** until it receives a radio telegram from the parameterized consumption meter.

Inquiry:	01 FE 93 20 RM S0 S1 S2 A0 A1 A2 A3 A4 A5 A6 A7 M0 TL [127 bytes] CRC CRC
Answer OK:	01 FE 07 20 00 CRC CRC
Answer error:	01 FE 07 20 FF CRC CRC

RM :	Wireless mode: 00 = auto, depending on the telegram received (T2, S2, C2) Others = invalid (C2 only with FW version 3.17 and higher)
S0, S1, S2	Transmission speed (chip rate) The registers for the transfer speed are calculated as shown below: $S[2,0] = 65536 - (12000000 / \text{chiprate})$ Examples: 100000 chip/s: S2 = 00, S1 = FF, S0 = 88 32768 chip/s: S2 = 00, S1 = FE, S0 = 91 (no longer supported with firmware versions 3.xx)
A0, A1, A2, A3,A4, A5, A6, A7	Address bytes (link layer) of the utility meter to which the radio telegram is to be sent. A0 = LSB of the manufacturer code A1 = MSB of the manufacturer code A2 = LSB of serial number 72 aquaradio® Mobile Receiver A3 = LSB+1 of the serial number A4 = LSB+2 of the serial number A5 = MSB of serial number A6 = version number A7 = Device Type
MON :	Options : 0x01 = Radio telegram transmitted once when a telegram has been received from the set consumption meter 0x02 = Radio telegram always transmitted when a telegram has been received from the set consumption meter 0x04 = Radio telegram transmitted once when a telegram has been received from any consumption meter 0x08 = Radio telegram always transmitted when a telegram has been received from any consumption meter 0x10 = Send radio telegram once immediately Autres = invalid If one of the options with continuous sending has been chosen, you can cancel the transmission if you send this command with TL = 0 (no data in the radio telegram). If one of the options that transmits when receiving any telegram is selected, then the address field of the radio telegram to be sent (byte 2 to byte 8) is automatically exchanged for the address field of the received telegram.
TL :	Number of bytes to be sent in the radio telegram (length of the radio telegram)
[127 octets]	The radio telegram to be sent. The radio telegram must contain all CRC bytes, but neither the radio preamble nor the synchronization word. The radio telegram is automatically transmitted in the Manchester code. With this command, 127 bytes must always be sent. The number of bytes to be sent is given in TL. Unused bytes should be set to FF.

To disable the transmission of radio frames, you must send this command with [TL] = 0.

9.12. Sending Radio Telegrams 2

The **aquaradio® Mobile Receiver** as a bidirectional radio transceiver is able to send radio telegrams. In general, the configured radio telegram is sent when a radio telegram has been received by the corresponding consumption meter. Therefore, this command can be used to configure up to 5 radio telegrams, which are not sent immediately, but are stored until a radio telegram has been received by the parameterized consumption meter.

NOTE: This command is only available with firmware version 3.17 or later.

NOTE: If the "Send Radio Telegrams" has been used and is still active ([TL] not equal to 0), then the configuration for "Send Radio Telegrams 2" will be ignored. The command "Send Radio Telegrams" must therefore be called once with the parameter [TL] = 0) in order to activate the "Send Radio Telegrams 2" configuration.

NOTE: The length field contains only the LSB of the effective length (0x116) of the command.

Inquiry:	01 FE 16 4B IX NO CT RM DL S0 S1 S2 A0 A1 A2 A3 A4 A5 A6 A7 TL [255 bytes] CRC CRC
Answer OK:	01 FE 07 4B 00 CRC CRC
Answer error:	01 FE 07 4B FF CRC CRC
IX :	Index of the radio telegram to be configured [1..5]. Invalid IX are ignored.
NU :	How often the radio telegram should be sent. 0 : send each time no radio telegram from the counter in question has been received. 1... 255: send radio telegram 1 to 255 times.
CT :	Delay setting (DL) in 0.5 ms, default = 0 01 = DL + 0.5 ms 02 = DL + 1 ms FF = DL - 0.5 ms FE = DL - 1 ms etc.
RM :	Bit encoded settings (FW version 3.44 or higher): 0xx00000 (bit 4 : 0) Ignores the bidirectional bit in the Config field 0xx10000 (bit 4 : 1) Takes into account the bidirectional bit in the Config field 000x0000 (bit 5+6 : 00) Do not add a CRC to the datagram 001x0000 (bit 5+6 : 01) Add CRC Format A to Datagram 010x0000 (bit 5+6 : 10) Add CRC Format B to Datagram (Format B: Length field of the radio datagram is automatically incremented by the added CRC bytes) 011x0000 (bit 5+6 : 11) Invalid (Do not add CRC to datagram)
Example:	RM=0x30 Takes into account the bidirectional bit in the Config field and adds CRC format A to the datagram.

DL :	Delay between the end of the radio telegram reception and the start of the transmission of the radio telegram [2... 254 ms]. Invalid values result in a 2 ms delay. DL = FF (recommended), automatic delay selection: Mode T2 = 2 ms Mode S2 = 10 ms Mode C2 = 100 ms (D-bit in the config field of the ELL = 1) Mode C2 = 1000 ms (D-bit in the Config field of the ELL = 0)
S0, S1, S2 :	Transmission rate (chip rate) 100000 chip/s: S2 = 01, S1 = 86, S0 = A0 32768 chip/s: S2 = 00, S1 = 80, S0 = 00 (not supported with FW version 3.xx)

To deactivate the radio telegram, this command must be sent with the correct index IX and [TL] = 0.

9.13. Sending Radio Telegrams 2 (EQS mode)

This command is basically the same as the previous command, except that the wireless mode (RM) is set to 0x80. In this case, the proprietary EQS mode is used.

NOTE: This command is only available with firmware version 3.34 or later.

NOTE: If the "Send Radio Telegrams" has been used and is still active ([TL] not equal to 0), then the configuration for "Send Radio Telegrams 2" will be ignored. The command "Send Radio Telegrams" must therefore be called once with the parameter [TL] = 0 in order to activate the "Send Radio Telegrams 2" configuration.

NOTE: The length field contains only the LSB of the effective length (0x116) of the command.

Inquiry:	01 FE 16 4B IX NU CT RM DL S0 S1 S2 A0 A1 A2 A3 A4 A5 A6 A7 TL NF CL CM [252 Bytes] CRC CRC
Answer OK:	01 FE 07 4B 00 CRC CRC
Answer error:	01 FE 07 4B FF CRC CRC

IX :	Index of the radio telegram to be configured [1..5]. Invalid IX are ignored.
NU :	Ignored, must be set to 0.
CT :	Delay setting (DL) in 0.5 ms, default = 0 01 = DL + 0.5 ms 02 = DL + 1 ms FF = DL - 0.5 ms FE = DL - 1 ms etc.
RM :	Wireless mode: 80 = EQS mode
DL :	always set to FF
S0, S1, S2 :	always set to S2 = 01, S1 = 86, S0 = A0

A0, A1, A2, A3, A4, A5, A6, A7:	Address bytes (link layer) of the utility meter to which the radio telegram is to be sent. A0 = LSB of the manufacturer code A1 = MSB of the manufacturer code A2 = LSB of the serial number A3 = LSB+1 of the serial number A4 = LSB+2 of the serial number A5 = MSB of serial number A6 = version number A7 = Device Type It is possible to occupy individual bytes with the M-Bus "Wildcard" 0xFF. In this case, the byte in question is ignored in the address comparison.
TL :	Number of payload/APL bytes ([252 bytes], starts with 2F 2F...)
NF :	Number of "frame to follow" to be sent after the initial SND_UD
CL :	Configuration word of the SND_UD (LSB)
CM :	Configuration word of the SND_UD (MSB)
[252 bytes] :	Payload / APL of the radio datagram to be sent (starts with 2F 2F ...) When using this command, the aquaradio® Mobile Receiver automatically assembles the correct radio datagram by adding LL (link layer) and TPL (transport layer). With this command, 252 bytes must always be sent. The number of payload / APL bytes is given in TL. Unused bytes should be set to FF.

To deactivate the radio telegram, this command must be sent with the correct index IX and [TL] = 0.

9.14. Send radio telegrams Configuration

This command is used to read the configuration of the transmitting radio frames (configured by "Transmit radio frames 2").

NOTE: This command is only available with firmware version 3.17 or later.

NOTE: The length field contains only the LSB of the effective length (0x116) of the command.

Inquiry:	01 FE 07 4C IX CRC CRC
Answer OK:	01 FE 16 4C IX NO CT RM DL S0 S1 S2 A0 A1 A2 A3 A4 A5 A6 A7 TL [255 bytes] CRC CRC
Answer error:	01 FE 07 4C FF CRC CRC

The parameters are identical to "Send Radio Telegrams 2", with the following exceptions:

IX :	[0] returns the configuration for "Send Radio Telegrams", [1... 5] returns the configuration for "Send Radio Telegrams 2".
CT :	Contains the counter of how many times the radio telegram in question has already been sent. If NU = 0, then CT counts up from 0x00 to 0xFF and then starts again from 0x00.

10. aquaradio® Mobile Receiver Readout Example with MBT1ReceiverLib

The MBT1ReceiverLib is a software library that contains functions for reading and parameterizing the MBT1 devices, including the **aquaradio® Mobile Receiver**. The examples listed below show how the **aquaradio® Mobile Receiver** can be read and how to communicate via the external serial port.

Sub aquaradio® Mobile ReceiverReading()

```
*****
MBT1COM = 12 'aquaradio® Mobile Receiver device is given the virtual COM port number COM12 'change this value according to your COM
port
*****
For RowCounter = 1 To 50 'clear all cells
For LineCounter = 1 To 200
Cells(LineCounter, RowCounter) = ""
Next LineCounter
Next RowCounter
Cells(1, 4) = "Running"
*****
Set aquaradio® Mobile Receiver = CreateObject("MBT1ReceiverLib.MBT1Receiver.1") 'invoke MBT1ReceiverLib software module
*****
-----'general settings
aquaradio® Mobile Receiver.RadioPasskey(1) = "FFFFFFFFFFFFFFFF" 'set 64 bit radio deciphering pass key 1 (if available)
aquaradio® Mobile Receiver.RadioPasskey(2) = "FFFFFFFFFFFFFFFF" 'set 64 bit radio deciphering pass key 2 (if available)
aquaradio® Mobile Receiver.RadioPasskey(3) = "FFFFFFFFFFFFFFFF" 'set 64 bit radio deciphering pass key 3 (if available)
aquaradio® Mobile Receiver.RadioPasskey128(1) = "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" 'Set 128 bit radio deciphering pass key 1 (if
available)
aquaradio® Mobile Receiver.RadioPasskey128(2) = "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" 'Set 128 bit radio deciphering pass key 2 (if
available)
aquaradio® Mobile Receiver.RadioPasskey128(3) = "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" 'Set 128 bit radio deciphering pass key 3 (if
available)
*****
aquaradio® Mobile Receiver.CurrentCOMPort = MBT1COM 'set the virtual COM port for the aquaradio® Mobile Receiver
'check the Bluetooth manager for the correct setting
aquaradio® Mobile Receiver.ReadParameter 'start with reading the parameter
From
DoEvents
Loop While aquaradio® Mobile Receiver.CommunicationThreadRuns <> 0
Cells(1, 1) = "aquaradio® Mobile Receiver"
Cells(1, 2) = aquaradio® Mobile Receiver.SerialNumber 'print out serial number of aquaradio® Mobile Receiverdevice
Cells(2, 1) = "Firmware"
Cells(2, 2) = aquaradio® Mobile Receiver.FirmwareVersion 'print out firmware version of aquaradio® Mobile Receiverdevice
If aquaradio® Mobile Receiver.SerialNumber = "" Then 'if the serial number is empty there is no device connected
Cells(3, 1) = "No MBT1Device connected"
GoTo aquaradio® Mobile ReceiverReadingEnd
End If
*****
Cells(4, 1) = "Reception Time"
Cells(4, 2) = "Manufacturer"
Cells(4, 3) = "Address"
Cells(4, 4) = "Signal Strength [%]"
Cells(4, 5) = "Generation"
Cells(4, 6) = "Medium"
Cells(4, 7) = "CI Field"
Cells(4, 8) = "Transmission Count"
Cells(4, 9) = "Status"
Cells(4, 10) = "Signature"
For Counter = 1 To 15
CellStr = "Value "
CellStr = CellStr + Str(Counter)
Cells(4, ((Counter * 2) + 9)) = CellStr
CellStr = "Unit "
CellStr = CellStr + Str(Counter)
Cells(4, ((Counter * 2) + 10)) = CellStr
Next Counter
TelegramRow = 5
StartTime = Now
aquaradio® Mobile Receiver.StartRadioReading 'start radio telegram reading
*****
Do 'read out the aquaradio® Mobile Receiver device for 15 seconds and display all values
DoEvents
TelegramStr = aquaradio® Mobile Receiver.NextRadioTelegram
```

```

If Left(TelegramStr, 2) <> "FF" Then 'if the telegram string contains FF there is no telegram available
TelValuesValid = aquaradio® Mobile Receiver.RADExtractDecipherValid(TelegramStr)
'get the deciphering successful flag
aquaradio® Mobile Receiver.TelegramInterpret Mid(TelegramStr, 17, 500), TelValuesValid
'interpret the telegram and its meter counts
Cells(TelegramRow, 1) = aquaradio® Mobile Receiver.RADExtractRecTime(TelegramStr)
Cells(TelegramRow, 2) = aquaradio® Mobile Receiver.RADManufacturer
Cells(TelegramRow, 3) = aquaradio® Mobile Receiver.RADDeviceAddress
Cells(TelegramRow, 4) = aquaradio® Mobile Receiver.RADExtractSignalStrength(TelegramStr)
Cells(TelegramRow, 5) = aquaradio® Mobile Receiver.RADGeneration
Cells(TelegramRow, 6) = aquaradio® Mobile Receiver.RADMedium
Cells(TelegramRow, 7) = aquaradio® Mobile Receiver.RADCIField
Cells(TelegramRow, 8) = aquaradio® Mobile Receiver.RADTransCount
Cells(TelegramRow, 9) = aquaradio® Mobile Receiver.RADStatus
Cells(TelegramRow, 10) = aquaradio® Mobile Receiver.RADSignature 'read the different values of the telegram header
NumberOfValues = aquaradio® Mobile Receiver.RADNumberOfDataRecords 'read the different meter counts
For Counter = 1 To NumberOfValues
Cells(TelegramRow, ((Counter * 2) + 9)) = aquaradio® Mobile Receiver.RADDataRecordValue(Counter)
Cells(TelegramRow, ((Counter * 2) + 10)) = aquaradio® Mobile Receiver.RADDataRecordUnit(Counter)
Next Counter
TelegramRow = TelegramRow + 1
End If
Loop While Now < StartTime + TimeValue("0 : 00 : 15") 'read the aquaradio® Mobile Receiver device for 15 seconds
*****
aquaradio® Mobile Receiver.CommunicationThreadBreak = 1 'Stop radio telegram reading
aquaradio® Mobile Receiver.ReadingEnd :
Cells(1, 4) = "Stopped"
End Sub
Sub aquaradio® Mobile Receiver.xtSerial()
*****
MBT1COM = 12 'aquaradio® Mobile Receiver device is given the virtual COM port number COM12
'change this value according to your COM port
*****
Set aquaradio® Mobile Receiver = CreateObject("MBT1ReceiverLib.MBT1Receiver.1") 'invoke MBT1ReceiverLib software module
*****
aquaradio® Mobile Receiver.CurrentCOMPort = MBT1COM 'set the virtual COM port for the aquaradio® Mobile Receiver
'check the Bluetooth manager for the correct setting
aquaradio® Mobile Receiver.ReadParameter 'start with reading the parameter
From
DoEvents
Loop While aquaradio® Mobile Receiver.CommunicationThreadRuns <> 0
Cells(1, 1) = "aquaradio® Mobile Receiver"
Cells(1, 2) = aquaradio® Mobile Receiver.SerialNumber 'print out serial number of aquaradio® Mobile Receiver device
Cells(2, 1) = "Firmware"
Cells(2, 2) = aquaradio® Mobile Receiver.FirmwareVersion 'print out firmware version of aquaradio® Mobile Receiver device
If aquaradio® Mobile Receiver.SerialNumber = "" Then 'if the serial number is empty there is no device connected
Cells(3, 1) = "No MBT1Device connected"
GoTo aquaradio® Mobile Receiver.ReadingEnd
End If
*****
SRequest = "1040FE3E16"
aquaradio® Mobile Receiver.BlueExtSerSendData 3, 2, 4, SRequest 'Initialize external serial interface and send a request command
From
DoEvents
Loop While aquaradio® Mobile Receiver.CommunicationThreadRuns <> 0 'Wait until the external serial interface request has finished
Cells(4, 1) = aquaradio® Mobile Receiver.BlueExtSerRecData 'Print out received data
aquaradio® Mobile Receiver.ReadingEnd :
Cells(1, 4) = "Stopped"
End Sub

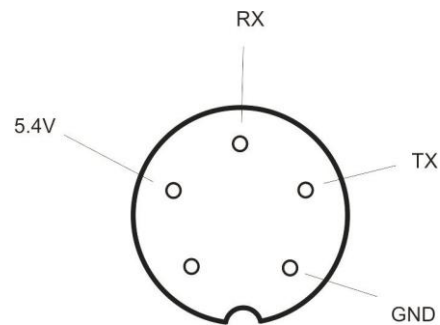
```

11. External serial port

The **aquaradio® Mobile Receiver** has a simple serial interface (TX / RX and power supply only), which can be used, for example, to connect optical or other meter configuration adapters. The maximum supply current is limited to 35 mA (5.4 V).



View of the connection pins from the outside



TX :	aquaradio® Mobile Receiver -> Externes Gerät	0=+5.4V; 1=-5.4V
RX :	Externes Gerät -> aquaradio® Mobile Receiver	0=+3.0 V ...+15.0V; 1=-3.0V...-15.0V
Supply:	+5.4V / 35 mA max.	

The matching counterpart to the **aquaradio® Mobile Receiver** socket is:



BINDER - 99-0413-00-05 Connector (5-pin)

12. Errors and fixes

If the **aquaradio® Mobile Receiver** does not seem to be working correctly according to this instruction manual, please verify the list of possible errors below:

- After pressing the power button, none of the indicators light up.
 - Charge the device for at least 4 hours.
 - If the error persists, please send the device in for repair.
- After the **aquaradio® mobile receiver** has fallen to the ground, it can no longer be switched on (no indicator lights up).
 - Plug in the charging adapter for 15 seconds, then turn it on again.
 - If the error persists, please send the device in for repair.
- After the charging adapter is connected, the battery charge indicator does not light up.
 - Verify that the battery charging adapter is correctly connected to the **aquaradio® Mobile Receiver**.
 - Verify that the battery charging adapter is correctly connected to the mains.
 - If the error persists, please send the device in for repair.

- It is not possible to establish a Bluetooth connection.
 - Verify that the **aquaradio® Mobile Receiver** is still switched on.
 - Verify that the **aquaradio® Mobile Receiver** was found correctly during the search for Bluetooth devices and repeat the Bluetooth search if necessary. Turn off the **aquaradio® Mobile Receiver** (by holding the power button for more than 5 seconds), wait 60 seconds and then turn the **aquaradio® Mobile Receiver** back on. Note that it is not possible to manually switch off the **aquaradio® Mobile Receiver** when a Bluetooth connection is established (Bluetooth connection indicator lights up orange).
 - Turn off your portable computer and restart it.
 - Use another computer to establish the Bluetooth connection to the **aquaradio® mobile receiver**.
 - If the error persists, please send the device in for repair.
- The battery life is shorter than specified.
 - If a high-power device is connected to the external serial port, the battery life will be shorter than specified. This depends on the power consumption of the external device and its duty cycle.
 - Lithium ion batteries age over time and their charging cycles. Normally, the capacity should still be 80% of the initial capacity after one year or 300 charging cycles. If the battery life becomes too short after a few years, it is possible to replace the lithium ion battery. To do this, send the device in for repair. Do not try to replace the battery yourself.
- The radio reception indicator and the power-on indicator flash red at the same time.
 - The internal self-test detected an error. Turn off the **aquaradio® Mobile Receiver** (by holding the power button for more than 5 seconds). Charge the device for at least 4 hours. Then turn the device on again.
 - If the error persists, please send the device in for repair.

13. Cleaning and care

- Clean the device with a soft cloth, which you lightly moisten with mild soapy water.
- Never use aggressive detergents or strong brushes.
- Disconnect the charging adapter from the **aquaradio® Mobile Receiver** when the battery is fully charged. Lithium Ion batteries do not have to be permanently connected to the charging adapter to maintain their state of charge.

14. Disposal Notes

The **aquaradio® Mobile Receiver** must not be disposed of together with household waste. Every consumer is obliged to dispose of all electrical or electronic equipment, whether or not it contains harmful substances, in an environmentally friendly manner. Therefore, at the end of its life, send the appliance to the manufacturer ("[Contact of the organization](#)" on [page 3](#)).

15. Technical data

Name:	aquaradio® Mobile Receiver
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Application:	Wireless receiver with Bluetooth interface
Locations:	Non-weatherproof mobile applications
Degree of protection:	IP 64
Radio Reception Frequency:	868 MHz / 434 MHz
Radio Reception Range:	Depending on the environment, up to 400 m (in the open field) or up to 30 m (indoors)
Radio receiver memory:	150 radio telegrams
Power supply:	3.7 volt lithium-ion battery (rechargeable)
Battery Life::	20 hours (without using the external serial port)
Battery Life Expectancy:	> 300 charging cycles
Ladeadapter:	Entrance: 100 V to 240 V AC 50 to 60 Hz 1.0 A max. Output: 5 V DC 3.0 A max. The charger should only be used in dry, weather-protected places.
Operating conditions:	-5° C to +55° C (not during battery charging) 0° C to +40° C (during battery charging) 10% to 95% relative humidity
Storage conditions:	-20° C to +45° C (less than 3 months) -20° C to +25° C (less than 1 year) To maintain at least 80% of the battery capacity
Dimensions:	Approx. 160 x 85 x 40 mm (without antenna) Antenna length approx. 180 mm
Weight:	about 300 g
Interface:	Bluetooth 4.1 (classic) Class 2 (10 m) Microchip BM77SPPx3MC2 Modul Bluetooth SIG QDID: B021961 EIRP: 4 dBm (2.5 mW) / Antenna gain: 0 dBi

Radio parameters receiver (version 868):

Frequency:	T1/C1: 868.95 MHz, S1: 868.3 MHz
Bandwidth:	200 kHz
Frequency Shift:	T1/S1 : 50 kHz, C1 : 45 kHz
Chiprate:	T1/C1 : 100,000 Chip/s, S1 : 32,768 Chip/s
Coding:	T1: 3 of 6 code, C1: keine, S1: Manchester

Radio parameters receiver (version 434):

Frequency:	T1/C1: 434.475 MHz, S1: 433.5 MHz
Bandwidth:	200 kHz
Frequency Shift:	T1/S1 : 50 kHz, C1 : 45 kHz
Chiprate:	T1/C1 : 100,000 Chip/s, S1 : 32,768 Chip/s
Coding:	T1: 3 of 6 code, C1: keine, S1: Manchester

Radio parameters transmitter (version 868):

Frequency:	T2/S2 : 868.3 MHz / C2 : 869.25 MHz
Frequency Shift:	T2/S2 : 50 kHz, C2 : 25 kHz
Chiprate:	T2/S2 : 32,768 Chip/s, C2 : 50,000 Chip/s
Coding:	T2/S2: Manchester, C2: none
Max. Output Power:	8 dBm (6.3 mW)
Antenna gain: 5 dBi	5 dBi
EIRP:	13 dBm (25 mW)

Radio parameters transmitter (version 434):

Frequency:	T2/S2/C2 : 433.5 MHz
Frequency Shift:	T2/S2 : 50 kHz, C2 : 25 kHz
Chiprate:	T2/S2 : 32,768 Chip/s, C2 : 50,000 Chip/s
Coding:	T2/S2: Manchester, C2: none
Max. Output Power:	5 dBm (3.2 mW)
Antenna gain: 5 dBi	5 dBi
EIRP:	10 dBm (10 mW)

Fulfilled directives / standards: 	ETSI EN 301 489-1 V1.8.1 (2008-04) class 2 ETSI EN 301 489-3 V1.4.1 (2002-08) class 2 SEARCH EN 301 489-17 V2.1.1 (2009-05) Non-specific Short Range Device (SRD) ETSI EN ETSI EN 300 220-1 V2.1.1 (2006-04) ETSI EN 300 220-2 V2.1.2 (2007-06) Receiver class 3 EN 60721-3-2 classes 2M2 / 2K2 EN 60721-3-7 classes 7M3 / 7K2 / 7Z14 IP 64
Test laboratory:	TÜV Süd Senton GmbH / Straubing / Germany